

loss in this study, previous work has been descriptive in nature, presenting the numbers of cases of hearing loss, presumed to have been noise induced or comparing hearing levels with reference populations.³⁻⁸ Both these descriptive methods have shortcomings: the former depends on the definition of noise induced hearing loss, and the latter depends on identifying a well matched reference population. Neither method of presentation is amenable to the necessary statistical testing. We believe that our method is suitable for estimating the risk of hearing loss in classical musicians as it does not depend on identifying cases but uses internal comparisons. Unfortunately, the numbers available limited the statistical power, but other orchestras might be recruited to an extended study.

Our study shows that there is a potential for hearing damage in classical musicians and that some form of protection from excessive sound may occasionally be needed.

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Mozart's scatological disorder

Benjamin Simkin

The surprising scatology found in Mozart's letters has not yet been satisfactorily explained. When the first English edition of the Mozart letters was published in 1938 all of the previously suppressed, unexpurgated letters were made available. In her introduction Emily Anderson stated: "It was not only when writing to his 'Bäse' (little cousin) that Mozart indulged in this particular kind of coarseness, but ... certainly his mother and very probably the whole family and indeed many of their Salzburg friends were given to these indelicate jests."¹ The possibility of Tourette's syndrome,² a syndrome of vocal and motor tics, was raised at the 1983 world congress of psychiatry in Vienna by Fog and Regeur, on the basis of Mozart's scatology and his portrayal in Peter Shaffer's stage play and motion picture, *Amadeus*. Peter Davies attributed Mozart's scatology to a hypomanic manifestation of his cyclothymic personality disorder.³ Steptoe echoed Anderson and regarded the scatology as a coarse, immature characteristic which Mozart retained in his adult life.⁴ With this background, this paper tabulates Mozart's scatology and suggests that its origin lay in Mozart's plausible affliction with Tourette's syndrome.

Incidence and characteristics of Mozart's scatology

The data on Mozart's scatology were obtained by a careful review of all of the published letters of Mozart and his family and are shown in the tables. Table I shows that scatology was present in 39 of the 371 letters written by Wolfgang Mozart, representing an incidence of 10.5%, whereas his father, mother, and sister contributed only one scatological letter each to the correspondence. This observation would seem to greatly diminish Anderson's argument that scatological writing was common to many Salzburgers, and in particular the whole Mozart family.¹

Table II lists the scatological terms found in the 39 letters, and it is evident that they focus on the buttocks and defecation. If all letters referring to anal matters, including some without scatology, are added up, the total number of anal letters rises to 45, for an incidence of 12.1%. Some scatological words were repeated more than once in some letters: shit (29 mentions), arse (24), muck (17), fart (6), piddling or pissing (6), arse holes (3). This expression of offensive oaths or foul mouthing is termed coprolalia. These words are similar to those used by the series of patients in New York with Tourette's syndrome reported by Shapiro in 1978.⁵

Several of Wolfgang Mozart's letters were peculiar in their obvious word games and word scrambling, in

the repetition of words just heard or written by someone else (echolalia), and in Mozart's repetitions of his own words (palilalia). There were a total of 23 such "bizarre" letters, for an incidence of 6.2%. This amalgam of coprolalia (scatology), echolalia, and palilalia suggested Tourette's syndrome as the common denominator, and was found in a total of 63 (17.0%) of Mozart's letters.

Table III shows an episodic clustering of Mozart's scatological and "bizarre" letters during his lifetime. There was a parallel incidence of scatology and other bizarre features in Mozart's letters. The first cluster occurred when he was 14, in 1770, the year of his triumphant first Italian tour, a tour of unremitting great excitement, great acclaim, and high honors—an emotional "high" for Mozart.

A second, more prolonged cluster of scatological and bizarre letters occurred in the five years between 1777 and 1781, an extremely unhappy and stressful period of Mozart's life, marked by the climax of his conflict with the Archbishop of Salzburg.

A small blip of scatological activity in 1783 coincided with the time of the birth of Mozart's first child, a son; the conflicting desires of his father and Jewish patron-landlord to be the child's namesake and godfather; and the unexpected death of the baby. Another small blip of scatological letters occurred in the spring of 1789,

TABLE I—Distribution of scatological letters in the Mozart family's correspondence

	No of letters	No (%) scatological
Wolfgang Amadeus Mozart	371	39 (10.5)
Maria Anna Mozart (mother)	40	1 (2.5)
Nannerl Mozart (sister)	15	1 (6.7)
Leopold Mozart (father)	319	1 (0.3)

TABLE II—Features suggestive of Tourette's syndrome in Wolfgang Amadeus Mozart's letters. Figures are numbers (percentages)

	No (%) of letters (n=371)
Features suggesting Tourette's syndrome	63 (17.0)
Buttocks and defecation	45 (12.1)
Scatology	39 (10.5)
Shit	21
Arse	19
Muck	7
Piddle or piss	6
Fart	4
Arse holes	3
Fondling and kissing, sexual fetish	4
Palilalia, echolalia, or word games	23 (6.2)

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Mozart's flute quartet in A. The instructions to performers are "Allegretto grazioso, ma non troppo presto, però non troppo adagio. Così-così-con molto garbo et espressione." Manuscript in Austrian National Library, Vienna; reproduced with permission of Ralf Wigender-Grass

when the financially straitened Mozart essayed an eight week concert tour to Berlin and other German towns in an effort to lighten his economic burden. The last flurry of scatological and bizarre letters occurred in the summer and fall months of 1791, at a time when Mozart was composing his last two major operas and his requiem in Vienna. To summarise, strong emotions seem to be related to the periodicity of scatology and other bizarre features in Mozart's letters.

Table IV shows that Mozart's father, his wife, his young female cousin, and his sister were the principal addressees of his coprolalia-echolalia-palilalia laden letters. Additionally, four non-family members each received one. Each of the nine people who received these unusual letters had established a close, personal relationship with Mozart, suggesting he had some degree of control of his scatology—it was not revealed to others at random, but only to those with whom he had personal bonds.

Evidence for Tourette's syndrome

The principal clinical features of Tourette's syndrome^{5,12} may be summarised as follows. It begins in childhood, usually between the ages of 5 and 15; the diagnostic symptoms are the occurrence of both motor and vocal tics, of mild to severe degree in different patients. Motor and vocal tics may not necessarily occur at the same time; one or the other may predominate; and their anatomical location, number, frequency, complexity, and severity may change over time. Coprolalia, the involuntary uttering of obscenities, is one of the most dramatic manifestations of Tourette's syndrome but is not essential to the diagnosis; its presence, however, confirms the diagnosis, and it occurs in a third to a half of all cases. The course is variable, usually lifelong, with remissions of weeks to years.

Tourette's syndrome is a genetic disorder transmitted as an autosomal dominant trait with a 3:1 predominance in males. One of the notable aspects of the syndrome is its wide ranging clinical expression: a continuum of mild, transient tics to the complete syndrome, consisting of a variable mix of vocal and motor tics, coprolalia, echolalia, and palilalia, along with the not infrequent association of attention deficit-hyperactivity disorder, learning disabilities, obsessive-compulsive traits, and compulsive self mutilation.

Although Mozart's scatology was abundant in his

letters, the evidence for his motor and vocal mannerisms had to be searched out from the mass of biographical material and others' memoirs. The stimulus for his personal descriptions was provided by Mozart's earliest biographers (Schlichtegroll, 1793¹³; Niemetschek, 1798¹⁴; Nissen, 1828¹⁵) with interviews of surviving family members: principally his sister Nannerl, his wife Constanze, his sister in law Sophie Haibel, and a lifelong intimate family friend, Johann Andreas Schachtner. As Mozart's posthumous reputation burgeoned, more and more physical descriptions appeared in the memoirs of various people who had known or met the great man. A total of 25 sources were found, 11 of which referred to Mozart's motor characteristics with a total of 21 citations, and six of which referred to his vocal characteristics. All told, 14 of Mozart's 25 first hand observers noted motor or vocal peculiarities. Henceforth, Mozart's motor and vocal mannerisms will be designated as "motor Touretisms" and "vocal Touretisms."¹⁶

MOTOR TOURETTISMS

Five sources described facial and bodily motor tics. One was Schlichtegroll's *Nekrolog* (1793):

He was thin and pale; and although the actual shape of his face was extraordinary, his expression was memorable in nothing save in its extreme variability. His features would alter from one instant to another, yet never revealing anything save the pleasure or the distress that he happened to feel in that immediate instant. He had one tic or idiosyncrasy which, as a general rule, is a symptom of stupidity: his body was perpetually in motion; he would play incessantly with his hands, or tap restlessly on the floor with his feet.¹³

TABLE III—Scatological letters related to greatly emotional periods of Mozart's life

Year	Event	No (%) of letters (n=371)		
		Total	Scatological	Compatible with Tourette's syndrome
1769		2	0	0
1770	First Italian tour	35	4 (11.4)	5 (14.3)
1771		17	0	1 (5.9)
1772		6	0	0
1773		8	0	0
1774		3	0	0
1775		3	0	0
1776		1	0	0
1777		32	13 (40.6)	14 (43.75)
1778	Climax of conflict with Archbishop of Salzburg	42	5 (11.9)	6 (14.3)
1779		3	2 (66.7)	2 (66.7)
1780		14	4 (28.6)	7 (50.0)
1781		51	1 (2.0)	5 (9.8)
1782		35	0	2 (5.7)
1783	Birth and death of first son	25	3 (12.0)	4 (16.0)
1784		13	0	2 (15.4)
1785		3	0	0
1786		3	0	0
1787		10	0	1 (10.0)
1788		5	0	0
1789	German tour	15	4 (26.7)	4 (26.7)
1790		19	0	0
1791	Composing two operas and requiem. Wife in Baden	26	3 (11.5)	10 (38.5)

TABLE IV—Recipients of Mozart's scatological letters

Recipient	No of letters	
	Scatological	Compatible with Tourette's syndrome
Leopold Mozart (father)	20	29
Constanze Mozart (wife)	6	12
Maria Anna Thekla Mozart (cousin)	6	8
Nannerl Mozart (sister)	4	6
Maria Anna Mozart (mother)	1	1
Mother and sister jointly	1	1
Non-family members	2	4
Baroness von Waldstadten		1
Abbé Bullinger	1	1
Choir Master Stoll	1	1
Baron Gottfried von Jacquin		1

A direct citation, attributable to a person in day to day contact with Mozart, was his sister in law's description of him, reproduced in Nissen's biography. Sophie Haibel, who nursed Mozart's wife during her confinements, described him as follows:

Even when he was washing his hands in the morning, he walked up and down in the room ... never standing still, tapped one heel against the other ... and was always deep in thought. At table he would often twist up a corner of a napkin and rub his upper lip with it, without appearing to know what he was doing, and he often made extraordinary grimaces with his mouth. ... Also, his hands and feet were always in motion, he was always playing with something, e.g. his hat, pockets, watch-fob, tables, chairs, as if they were a clavier.¹⁷

The Irish tenor Michael Kelly, a member of the original cast of Mozart's *The Marriage of Figaro*, recalled: "I never shall forget his little animated countenance, when lighted up with the glowing rays of genius; it is as impossible to describe it, as it would be to paint sunbeams."¹⁸ Mozart's elder sister in law, Frau Hofer, described the "restless movements of his hands" and the "movements of his lips" at the opera.¹⁹ His wife, Constanze, described his impatient stamping with his feet and his "Saperlotte!" exclamations when things did not go correctly in the orchestra.²⁰ Johannes Hummel described Mozart's "touching" compulsion during his little son's successful piano audition:

Mozart nudged me gently with his arm a few times ... suddenly put his hand on my knee, pressed it gently. ... He then put his hand on the boy's head, took him by the hand, and put him on his lap petting him continually.²⁰

Mozart's most remarkable motor Tourettism was his motor hyperactivity while composing. His widow, Constanze, stated that Mozart composed walking about the apartment, quite abstracted. He would then sit down by her, ask for ink and paper, and notate the music as she recounted the day's events at his request. She further stated that "he could never entirely abstract himself from his musical thoughts" and composed while playing billiards or conversing with friends.²⁰ Jahn wrote: We have already observed that musical ideas occupied him during all bodily exercises,

such as riding, bowls and billiard-playing. General conversation, as Frau Haibel says, did not disturb his mental labours.¹⁹

HYPERACTIVITY

Several of the descriptions already cited provide elements of hyperactivity, further strengthened by the following anecdotes. Ludwig Tieck accosted Mozart in the orchestra pit of the theatre: He was small, rapid of movement, restless, going from one music-desk to the next, an unprepossessing figure in a grey overcoat.²¹

Jahn wrote: The contrabassist Ludwig ... used to tell how the piano stood upon the stage, and how during the rehearsal the restless, agile little man was continually leaping over the prompter's box into the orchestra to chat in a friendly way with the various performers, and then climb back again on to the stage.¹⁹

VOCAL TOURETTISMS

The evidence for Mozart's vocal Tourettisms was multifactorial: six anecdotal citations by personages close to him, two musical compositions, and his 63 "bizarre" letters. The most dramatic citation was Karoline Pichler's account:

For he hummed the melody (from Figaro) as I played and beat the time on my shoulders. ... He suddenly moved a chair up, sat down, told me to carry on playing the bass, and began to improvise such wonderfully beautiful variations that every one listened to the tones of the German Orpheus with bated breath. But then he suddenly tired of it, jumped up, and, in the mad mood which so often came over him, he began to leap over tables and chairs, miaow like a cat, and turn somersaults like an unruly boy.²²

This story underscored several notable features: the hushed atmosphere of a Mozartean improvisation, followed by sudden, impulsive motor and vocal Tourettisms, and indicates that Mozart's eccentric behaviour was not unusual. The raconteur knew Mozart well as a regular participant of her father's weekly musical salons. Since Mozart improvised on an air from *Figaro*, this anecdote can be dated between 1786 and 1789.

About this time Mozart seemed to have a "miaow" preoccupation, with two additional attributions. Mozart's tempo marking for the finale of his 1786 flute quartet (K298) was: "Rondo-miaow/Allegretto grazioso but not too presto, but not too adagio either. So-so ... with much charm and expression." It is for each listener to divine the "miaow" aspects of the music. In 1790 Mozart collaborated with Benedikt Schack on the music of several Schikaneder operas. Lipowsky wrote in 1811 that when Kapellmeister Mozart came to take Schack for a walk he "would sit down at his desk and compose a piece here and there in his operas."²³ One such piece was K625, "Nun, liebes Weibchen, zeihst mit mir," a comic song scored for soprano and bass with orchestral accompaniment, a series of two line verses sung by the bass, answered each time by the soprano with a constant, unwavering series of miaows: "miaow, miaow, miaow, miaow."

Another Mozartean vocal peculiarity was his life-long penchant for nonsense words and make believe, odd sounding names, and nicknames. Sources were his sister, his wife, his letters, and comic canons and songs with texts by Mozart. Examples abound. In childhood: Mozart's bedtime singing of a tune to his own nonsense words, "oragnia figarafa," and his childhood imaginary Kingdom of Back.²⁴ The "Bäsele" letters (1777-80) include Duchess Smackbottom, Countess Makewater, Princess Dunghill, Prince Potbelly von Pigtail, the villages of Tribsterill and Burmesquik, Shit-Dibitari, Zizibe, and Munsch-lauser. In 1787 he had nicknames for Baron von



1791—Mozart is commissioned to write a requiem. A cluster of scatological and bizarre letters occurs during this year

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Jacquin's musical circle: Hinkity Honky, Punkititi, Schlaba Pumfa, Royka-Pumpa, Natschibinitshibi, Sagadarata, Schlamanuzkey, Runzi-funzi, Ramlois-Schurimiri, Gaulimaui, Blatterizi, Signora Diniminimi. Letters to his wife in 1789 and 1791 include Schluck and Druck, Spitzgnos, the exclamations Schlumba and Saperlotte, Stachelschwein, "nu, nu, nu, nu," Stanzi-marini, Plumpa-Strumpi, Lacci Bacci, Snai.¹

Certain words or phrases reflecting perseverating obsessive thoughts can be found in Mozart's B  le letters: sensible, Tom has the purse and Dick has the gold, Spuni cuni business, why not?, however that may be. Mozart clangs on the word "muck" in one letter, and in his 1791 letters to his wife, "Snai," Mozart's nickname for his pupil Sussmayr appears 10 times in six letters.

Although Mozart's scatology was abundantly evident in written form in his letters (coprographia), did he actually speak that way? Mozart himself answered this for us in the affirmative in two 1777 letters to his father, with later confirmation by his brother in law Joseph Lange. At the end of a serious letter (17 October 1777) Mozart spoke of singing a canon with "a certain Father Emilian" in which "I took the third voice," intoning sotto voce a different text, "Pater Emilian, oh, you idiot, you lick my arse, I beg you."²⁵ Just one month later Mozart "confessed" to his father that on several occasions he entertained his host, the director of the world famed Mannheim Orchestra, along with his family and important orchestra members, by reciting after dinner scatological rhymes by the hour: "I did frequently, without any difficulty, but quite easily, perpetrate . . . rhymes, the same being, moreover, sheer garbage, that is, on such subjects as muck, shitting and arse-licking."

A perceptive commentary on Mozart's apparently involuntary, vulgar vocalisations was provided by Joseph Lange, a famous actor and talented amateur artist, who painted portraits of Mozart in 1782 and 1789. He recalled in his memoirs:

Never was Mozart less recognizably a great man in his conversation and actions, than when he was busied with an important work. At such times he not only spoke confusedly and disconnectedly, but occasionally made jests of a nature which one did not expect of him, indeed he even deliberately forgot himself in his behaviour. . . . Either he intentionally concealed his inner tension behind superficial frivolity . . . or he took delight into throwing into sharp contrast the divine ideas of his music and these sudden outbursts of vulgar platitudes.²⁶

Discussion

The accumulation of evidence reported here supports the proposition that Mozart fulfilled the current criteria for Tourette's syndrome.¹² In the absence of full agreement about precise clinical features and of specific laboratory markers, Sacks's admonition is pertinent: "Every experience with a Tourette person is a new experience; you see things you've never seen before, you learn things you never learned before."²⁶

Aetiologic concepts of Tourette's syndrome have evolved over time from consideration of psychogenic factors to organic neurological disease, genetic and brain neurotransmitter disorders,^{5,12} and most recently metabolic brain dysfunction (the attention deficit-hyperactivity disorder).²⁷ Comings *et al* recently included Tourette's syndrome in a group of behavioural disorders associated with increased frequency of alcohol abuse, defects in dopamine neurotransmission, and increased prevalence of a modifying gene, the A₁ allele of the dopamine D₂ receptor gene.²⁸ They further stated that the similar prevalence of the A₁ allele in Tourette's syndrome, attention deficit-hyperactivity

disorder, autism, alcoholism, drug abuse and post-traumatic stress disorder "is consistent with a spectrum of disorders that share common pathophysiological genetic mechanisms. These disorders have in common a substrate of impulsive-compulsive-addictive behaviors." Rather than a rigidly defined eponymic syndrome, it would be more fruitful to consider a spectrum of disorders based on common mechanisms, and in Mozart's case the interaction of genius on such disorders.

A psychoanalytic paper by Mahler and Rangell published in 1943 was the first to state an organic substrate for Tourette's syndrome, and considered these patients to be afflicted with a dysfunction of motor expression characterised by "incontinence of the emotions . . . as if the system of expressional motility were in a state of permanent overexcitation" without normal control.²⁹ This concept predated the later biochemical dopaminergic dysfunction theory. In this connection, two of Mozart's stunning creative feats were his wealth of melodic invention and his legendary ability to compose music in his head.

There is a striking similarity between Mozart, with music in his mind the whole day long, and Samuel Johnson, the great English man of letters, with his day long recitations of literary pieces and pious sayings. Johnson was probably afflicted with a severe form of Tourette's syndrome, characterised by severe motor tics, involuntary vocalisations, compulsive verbal and motor acts, and repeated personal recitations of long religious and literary tracts, for which his memory was legendary.³⁰ Mozart's similarly legendary musical memory enabled him to write down whole compositions, previously composed in his head, even in the midst of convivial social occasions. The concept of "incontinence of the emotions" might well serve as the connecting link between two of the intellectual giants of the eighteenth century, both of whom were touched with aspects of Tourette's syndrome.

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Music making

R L Kneebone

Last year I built a harpsichord from a kit. The idea of doing this had been fluttering about at the back of my mind for many years, but only when I decided to take the plunge did I really begin to learn what it would involve.

First I went to the early music exhibition in London. This takes place every two years, and all manner of curious people congregate there. Before I went I had thought that superspecialisation was the peculiar province of doctors. I was quite wrong. The early music world's answer to the neonatal neuroendocrinologist is someone whose life is spent designing the complex tools which instrument makers use to carve the scrolls of baroque viols.

The exhibition was full of instruments that I had only ever read about—and some I had never even heard of. There were hurdy-gurdies, serpents, crumhorns, shawms, theorbos, and all sorts of even rarer breeds. I even had a go on a quint bass curtal.

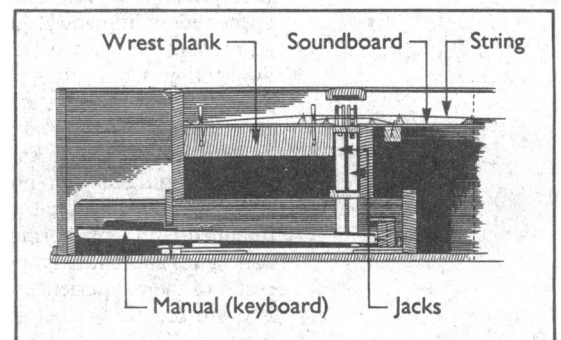
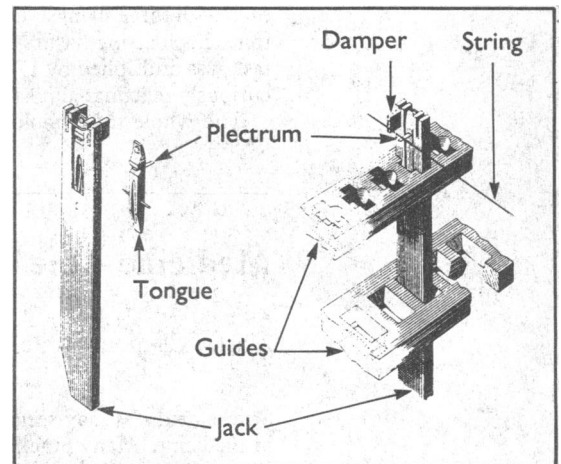
Of the several makers of harpsichord kits, by far the best was John Storrs of Chichester. His kits are based closely on traditional designs and use mainly traditional materials. He uses computerised equipment, though, to make the really tricky parts where a novice could easily go dreadfully wrong. I ordered my kit from him.

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The "Flemish harpsichord," pleasing to the eye as well as the ear, can be built from a kit



Harpsichord action: (top) the plectrum fits into the tongue, which fits into the jack, which is held in position by guides and rests on the key; (bottom) the cross section shows how the string is held by tuning pins fitted into the wrest plank and runs over the soundboard. When the key is depressed the plectrum rises and plucks the string; when the key is released the damper descends to stop the string vibrating. A two manual harpsichord is shown

A couple of months later my kit arrived. I took a fortnight's "harpsichord leave" from the practice and began. The number of bits and pieces was formidable, but the instructions in the booklet seemed very clear. I started at once—and nearly fell at the first fence.

As instructed, I started with a dummy run and fitted the bits together without glue. That seemed fine, except that I found I had put the wrest plank in back to front. This is like building a car and putting the pedals on the ceiling and the sunroof under the seat.

I took my kit to bits again, covered the parts with glue and cramped it all together. This time I made quite sure that the wrest plank was not back to front—but put it in upside down instead. I just managed to get it to come unstuck before it did the same to me.

The mechanism of the harpsichord seems absurdly simple, but it works amazingly well. On the distal end of each key are the jacks. Each has a little wooden tongue that pivots sideways; this tongue holds the plectrum. This plectrum plucks the string on its way up and swivels out of its way as it comes back. Because

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